ARIZONA DEPARTMENT OF HEALTH SERVICES

BUREAU OF EMERGENCY MEDICAL SERVICES AND TRAUMA SYSTEM

LEVEL I TRAUMA CENTERS

MEASURING TRAUMA OUTCOMES UTILIZING THE Z STATISTIC

ASTR 2008-2011

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Trauma Outcomes Utilizing Z-Statistic

Objective: To analyze outcomes of trauma patients at Level I trauma centers. [1, 2]

LIMITATIONS: Predictive models like TRISS are unable to control for variables not included in the calculations (such as co-morbidities), and cannot explain inconsistencies in patient outcome. Patients were included in the analysis if all of the necessary data elements were completed. ISS calculations are based on the three most serious injury Abbreviated Injury Severity (AIS) Scores to any body region.

Methods: The adult trauma patient analysis included seven designated level 1 trauma centers. The analysis for pediatric trauma patient includes all eight designated level 1 trauma centers. Data was provided from the Arizona State Trauma Registry (ASTR) during 2008-2011.

The ASTR data were restricted to mirror the NTDB study population (admission, transfer, and outcome statuses).

Inclusion criteria: At least one valid trauma ICD-9 code in the range of 800-959.9.
Primary mechanism of injury classified as either blunt or penetrating.
The ASTR participating hospitals should be a Level I Trauma Center.

Exclusion Criteria: Dead on Arrival.
Unknown vital signs like, ED systolic blood pressure, ED GCS and ED respiratory rate.
Pediatric penetrating injuries (NTDB study showed unreliable TRISS coefficients).

The TRISS model[1] gives the probability of survival (Ps) based on the revised trauma score (RTS), injury severity score (ISS) and age. The Z-statistic , W-statistic and the O/E ratio were then calculated using the survival probability and the revised coefficients[2].

A Z score of 1.96 or higher indicates significantly better performance than expected and a Z score of –1.96 and lower indicates significantly less performance than expected.

An Observed /Expected ratio shows how well a trauma center is performing. An O/E ratio must always consider upper and lower limits of the 95% confidence interval (CI) . An O/E ratio AND CI that is less than one indicates a significantly lower mortality than expected. An O/E ratio AND CI greater than one indicates a significantly higher mortality than expected. A ratio that has a CI that overlaps one means that the observed mortality is the same as expected.

One important note is that the different analyses (Z-statistic and O/E ratio) are independent of each other and may have contradictory results.

[1]Boyd, C.R., Tolson, M.A., Copes, W.S. (1987). Evaluating trauma care: the TRISS method. *Journal of Trauma, 27, 370- 378.*

[2]Schulter, P., Mathens, A., Neal, M., Golble, S., Cameron, C., Davey, T., McClure, R. (2010). Trauma and injury severity score (TRISS) coefficients 2009 revision. *The Journal of Trauma Injury, Infection, and Critical Care , 68, 4.*

Arizona Statewide Aggregate Report

All seven Level I trauma centers were blinded and are presented individually as Hospital A-G.

For the aggregate data there were a total of 50,036 blunt trauma patients from seven level I trauma centers from 2008 to 2011 (Table 1) and 7,957 penetrating trauma patients (Table 2) .

Adult Blunt Trauma: Statewide aggregate results had three statistically significant year (2008, 2009, 2011) which resulted in less deaths than what is expected. For all the combined year (2008-2011) statewide aggregate results had a better than expected outcome for blunt trauma (z-score AND O/E ratio).

Adult Penetrating Trauma: Statewide aggregate results had no single year which showed less deaths than what is expected. For all the combined year (2008-2011) statewide aggregate results had a better than expected outcome for penetrating trauma (only z– score).

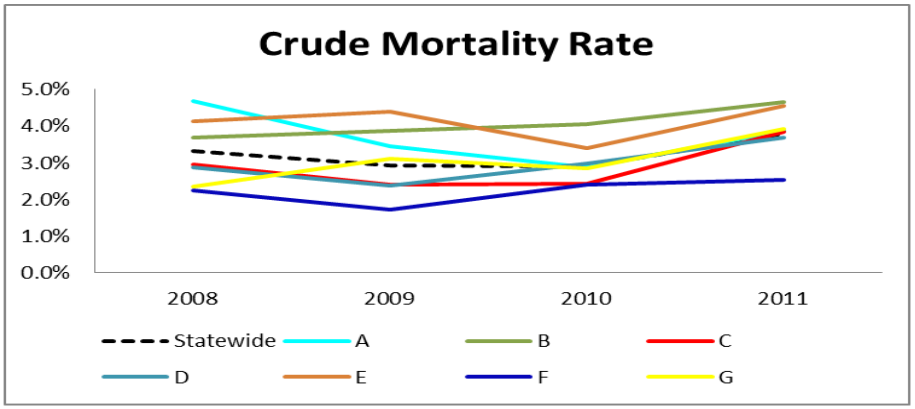
Pediatric Blunt Trauma: Statewide aggregate results had no single year which showed less deaths than what is expected. For all the combined year (2008-2011) statewide aggregate results had the same as expected outcome for pediatric blunt trauma. Individual year data were not shown because of statistical unreliability with sample sizes of <25.

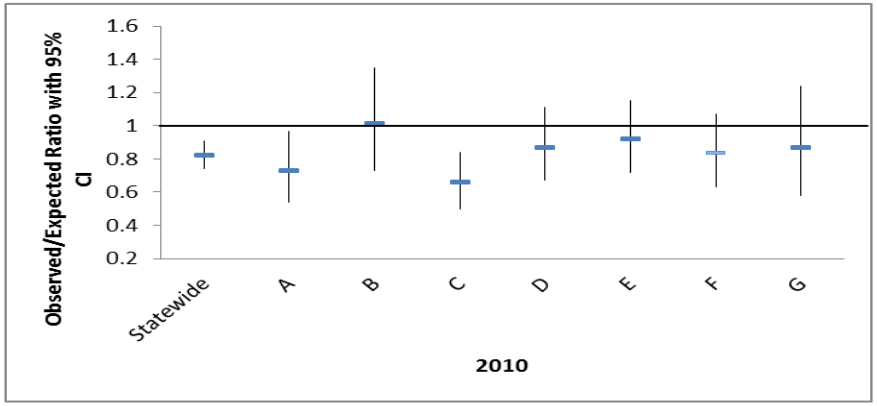
Blunt Trauma (Age ≥ 15 yrs)

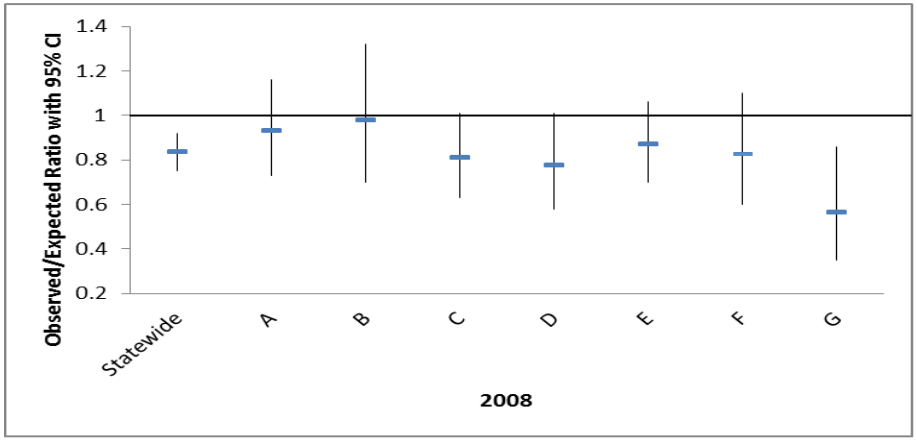
Table 1: Adults (>=15 yrs) with a mechanism of blunt trauma: Z-statistic and W Score based on NTDB Study

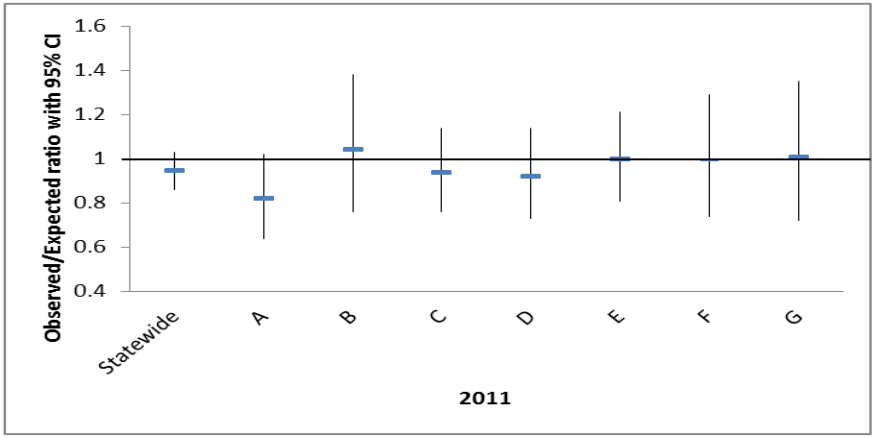
There were a total of 50,036 blunt trauma patients from seven level I trauma centers from 2008 to 2011. Overall, the complete RTS data were available for 49,179 (98.3%) patients. The average Ps for those who died was 0.58. Conversely, those who survived had an average Ps of 0.97. The W-statistic of 0.54 and the Z-statistic of 7.51 suggest that there were significantly more survivors than expected; 0.54 excess survivors over every 100 patients. Additionally, the overall O/E ratio of 0.86 suggests that there were 14% lower deaths occurred than expected among adult patients with a mechanism of blunt trauma.

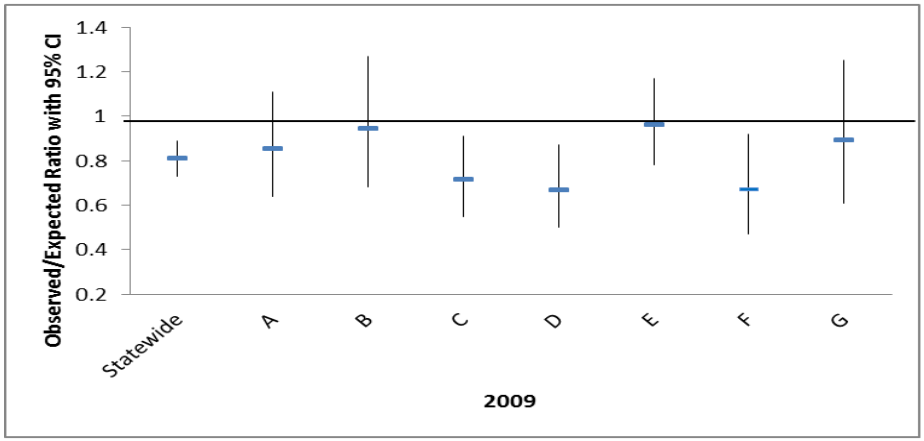
	2008	2009	2010	2011	2008-2011
2008-2011	**Statewide**	**Statewide**	**Statewide**	**Statewide**	**Statewide**
Number of Patients	11,981	12,645	12,641	12,769	50,036
Number of Deaths	395	373	368	488	1,624
Number of Survivors	11,586	12,272	12,273	12,281	48,412
Mortality Percentage	3.30%	2.95%	2.91%	3.82%	3.25%
Number of Patients RTS Data Available	11,592	12,364	12,527	12,696	49,179
Number of Deaths	383	362	362	482	1,589
Number of Survivors	11,209	12,002	12,165	12,214	47,590
Mortality Percentage	3.30%	2.93%	2.89%	3.80%	3.23%
Expected Survivors	11,135.37	11,917.61	12,087.28	12,186.62	47,326.88
Expected Deaths	456.64	446.39	439.72	509.38	1,852.12
Average Ps	0.96	0.96	0.97	0.96	0.96
Average Ps Deaths	0.61	0.61	0.62	0.58	0.58
Average Ps Survivors	0.97	0.97	0.98	0.98	0.98
Z score	4.27	4.85	4.46	1.53	7.51
W -statistics	0.64	0.68	0.62	0.22	0.54
O/E ratio	0.84	0.81	0.82	0.95	0.86
LL	0.75	0.73	0.74	0.86	0.81
UL	0.92	0.89	0.91	1.03	0.90

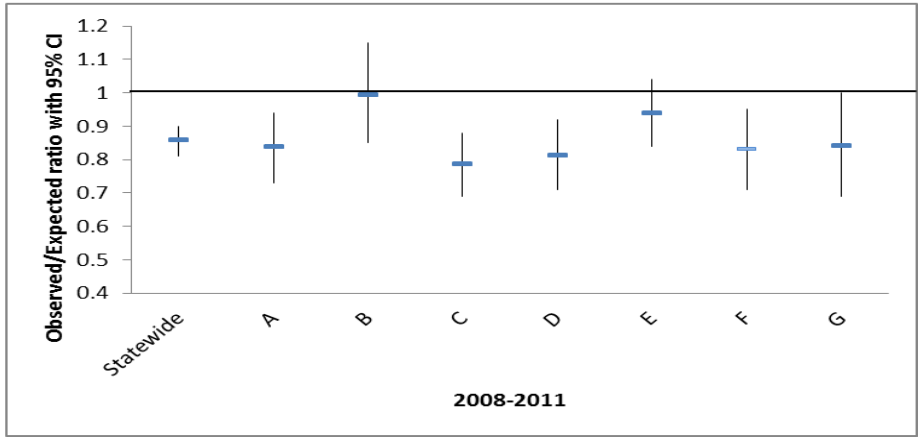












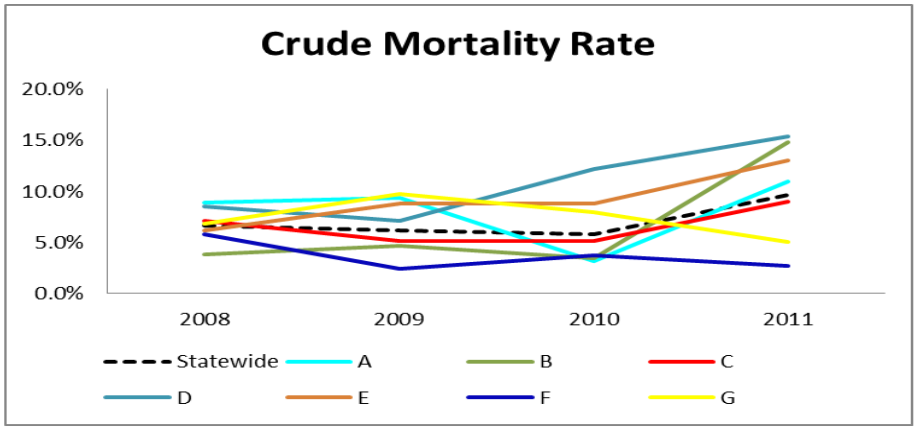
In 2008, 2009 and 2010, statewide aggregate results showed less mortality than what is expected. In 2011, statewide aggregate results had same mortality as is expected in a trauma center. For all years combined 2008-2011, the aggregate showed better outcomes than what is expected .

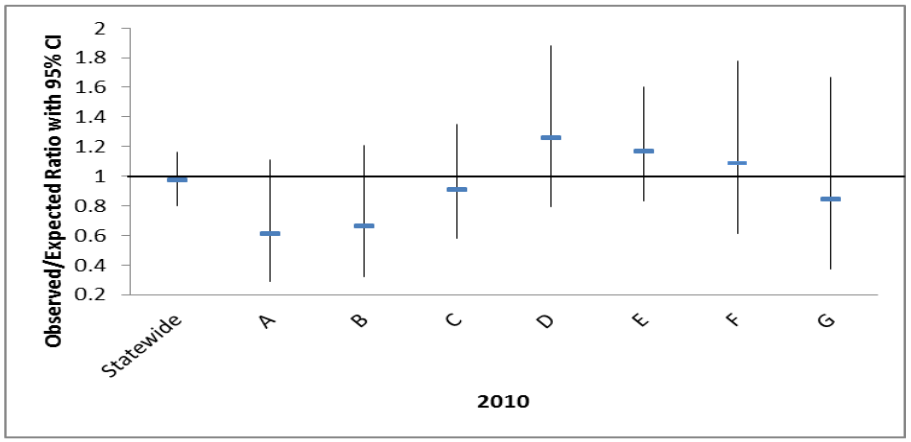
Penetrating Trauma (Age ≥ 15 yrs)

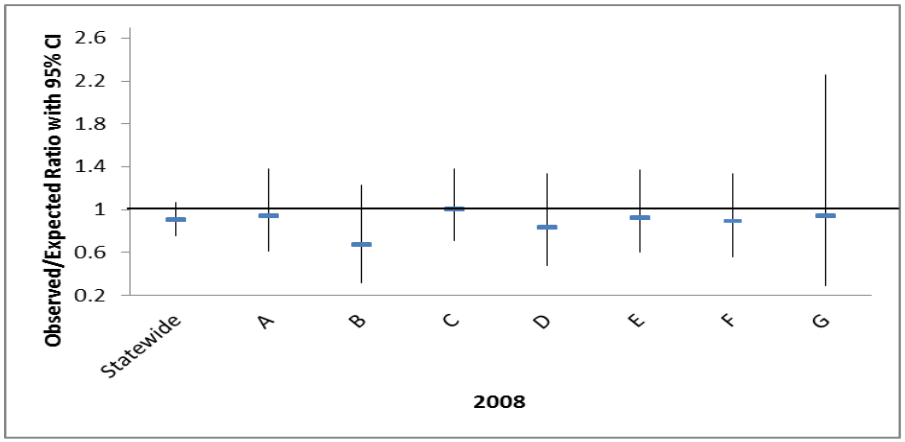
There were a total of 7,957 adult patients with a mechanism of penetrating trauma from the seven level I trauma centers from 2008 to 2011 (Table 2). Overall, the complete RTS data were available for 7,800 (98.0%) patients. The average Ps for those who died was 0.31. Conversely, the average Ps for survivors was 0.97. The W-statistic of 0.3 and the Z-statistic of 4.3 suggested that there were significantly more survivors than expected; 0.3 excess survivors over every 100 patients. The overall O/E ratio of 0.96 with 95 % CI of 0.8-1.0 suggested that the observed mortality was same as expected.

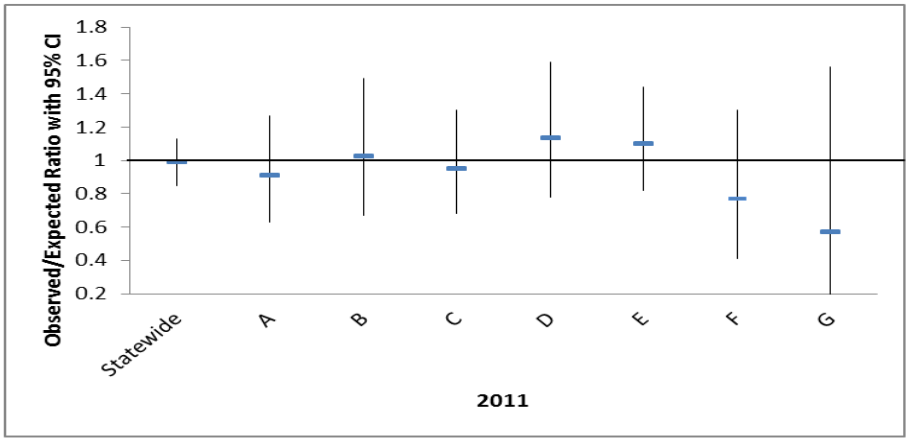
Table 2: Adults (>=15 yrs) with a mechanism of penetrating trauma: Z-statistic and W Score

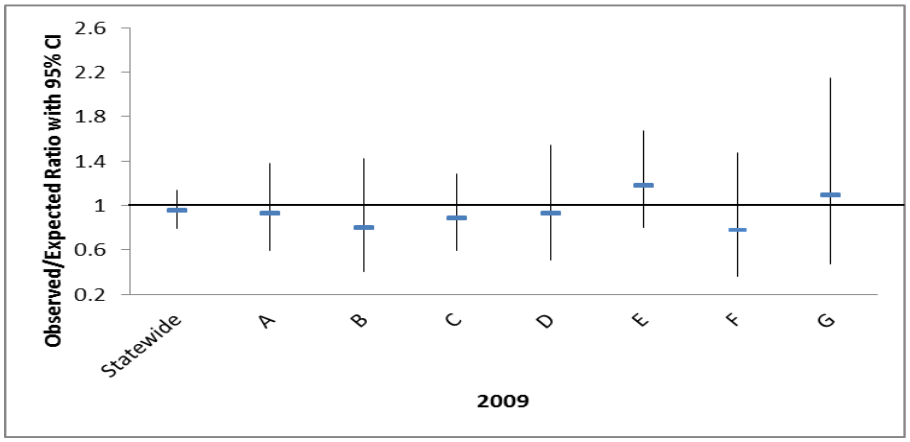
	2008	2009	2010	2011	2008-2011
2008-2011	**Statewide**	**Statewide**	**Statewide**	**Statewide**	**Statewide**
Number of Patients	2,026	1,901	2,062	1,968	7,957
Number of Deaths	134	116	123	191	564
Number of Survivors	1,892	1,785	1,939	1,777	7,393
Mortality Percentage	6.61%	6.10%	5.97%	9.71%	7.09%
Number of Patients RTS Data Available	1,954	1,869	2,027	1,950	7,800
Number of Deaths	130	115	118	188	551
Number of Survivors	1,824	1,754	1,909	1,762	7,249
Mortality Percentage	6.65%	6.15%	5.82%	9.64%	7.06%
Expected Survivors	1,810.87	1,748.46	1,905.84	1,760.17	7,225.35
Expected Deaths	143.13	120.54	121.16	189.83	574.65
Average Ps	0.93	0.94	0.94	0.90	0.93
Average Ps Deaths	0.35	0.34	0.36	0.24	0.31
Average Ps Survivors	0.97	0.97	0.98	0.97	0.97
Z score	1.71	0.79	0.46	0.25	4.33
W -statistics	0.67	0.30	0.16	0.09	0.30
O/E ratio	0.91	0.95	0.97	0.99	0.96
LL	0.76	0.79	0.80	0.85	0.88
UL	1.07	1.14	1.16	1.13	1.04

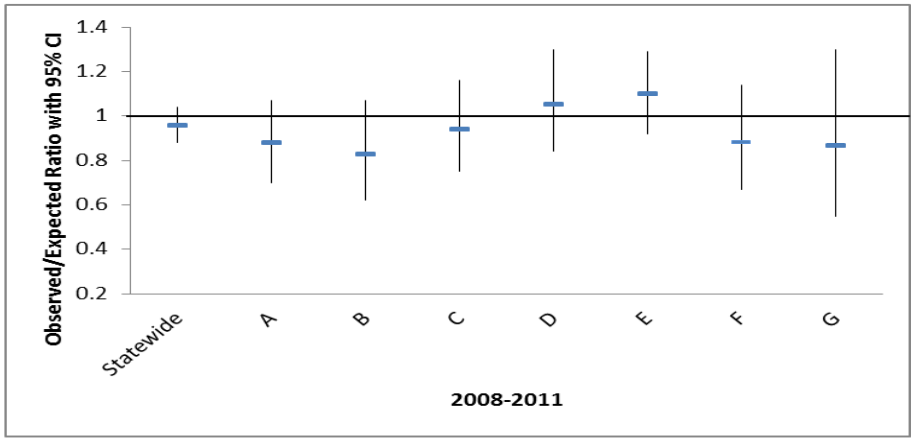












For the individual years, Statewide aggregate results had same mortality as is expected. Overall adult penetrating trauma outcome is also same as is expected for 2008-2011.

State Blunt Trauma (Age < 15 yrs)

There were a total of 8,371 pediatric patients with a mechanism of blunt trauma from eight level I trauma centers from 2008 to 2011(Table 6).

Overall, the complete RTS data were available for 7,367 (88%) patients. The average Ps for those who died was 0.54. Conversely, the average Ps for survivors was 0.99. The W-statistic of -0.13 and the Z-statistic of -1.36 suggested that these patients had a survival ratio that was the same as expected. Lastly, the overall O/E ratio of 1.11 with 95 % CI of 0.9-1.3 also suggested that the observed mortality was the same as expected.

Table 6: Pediatrics (<15 yrs) with a mechanism of blunt trauma: Z-statistic and W score

2008-2011	Statewide
Number of Patients	8,371
Number of Deaths	99
Number of Survivors	8,272
Mortality Percentage	1.18%
Number of Patients RTS Data Available	7,367
Number of Deaths	92
Number of Survivors	7,275
Mortality Percentage	1.25%
Expected Survivors	7,284.29
Expected Deaths	82.71
Average Ps	0.99
Average Ps Deaths	0.54
Average Ps Survivors	0.99
Z score	-1.36
W -statistics	-0.13
O/E ratio	1.11
LL	0.90
UL	1.35